The five years which Pasteur spent upon this successful, though harassing, inquiry told terribly upon his health, and he was struck down by a paralytic seizure, from the physical effects of which he never absolutely recovered, though the clearness of his intellect was never for a moment impaired. His researches on silkworm diseases, and his long and intimate contact with fermentation phenomena, gradually paved the way for the momentous step which led him, at the already ripe age of fifty-five, to enter upon the study of diseases in the pursuit of which he was to win his most glorious laurels. Prof. Frankland described how Pasteur, after much hesitation, was led himself to embark upon this quest in consequence of his anxiety lest through exaggerated statements and undue haste in drawing conclusions—a tendency exhibited by many who at this time took up the bacteriological study of diseases—a reaction should be provoked, and the new ideas consequently fall into disfavour. Pasteur commenced his campaign by investigating the disease known as anthrax; but even while carrying on the most elaborate researches on this subject, he was turning in all directions for material to extend his studies on pathological phenomena. He walks the hospitals, armed with sterile vessels, to collect morbid products; he isolates the staphylococcus pyogenes; he visits the Maternity Hospital, and discovers the streptococcus pyogenes, asserting it to be the cause of puerperal fever. But the occupation of discovering pathogenic bacteria, fascinating as it was, could not permanently engross Pasteur's attention, and his ambition, stimulated by the contemplation of Jenner's great discovery, led him to seek a means of securing immunity from those diseases of which the specific viruses had been discovered, similar to that which his great predecessor had secured in the case of small-pox. Pasteur's discovery of a vaccine for fowl cholera was soon followed by vaccines for *Rouget de porc* or swine measles, and for anthrax, the saving to his country by the use of the anthrax vaccine alone having amounted to no less than 280,000*l.* in the course of the ten years from 1884 to 1894. The magnificent triumph which followed the discovery of these vaccines was, however, if possible, eclipsed by the elaboration of a cure for rabies; nearly 20,000 persons have undergone Pasteur's anti-rabic treatment, and the mortality amongst these treated persons has been less than 5 per 1000. The public expression of gratitude for this great discovery, concluded the lecturer, took the form of a general subscription, which rendered possible the foundation of the Institut Pasteur, which its great namesake had long cherished as a dream, and the realisation of which was the delight of his few remaining years; and here, under the auspices of Duclaux, Roux, Chamberland, and Metschnikoff, the sacred fire kindled by *le grand Maître* is still burning. Long may this flame be fed within the temple where now rests in eternal sleep that hero of science, whose greatest ambition was to be able, in his last hour, to pronounce the words, so simple in their form, so boundless in their aspiration, *j'ai fait ce que j'ai pu.*

THE DIAMOND MINES OF KIMBERLEY.[1]

It is a standing surprise to the watchful outsider how little attention is bestowed on some of our colonies. For instance, to the Cape Colony, comprising vast, varied, and productive regions, we have till recently manifested profound ignorance and consequent indifference. When the Cape Colony was first incorporated with the Empire, it was pronounced "a bauble, unworthy of thanks." Yet before the Suez Canal and the Waghorn overland route to India, the Cape, as commanding our road to India, Australia, and China, had a special importance. Even now it presents an alternative route which under conceivable circumstances may be of capital moment.

The high grounds above Cape Town are rich in medicinal health-giving waters. The districts where these springs occur are high-lying, free from malaria, and admirably adapted for the restoration of invalids. It needs only some distinguished power to set the fashion, some emperor, prince, or reigning beauty to take the baths and drink the waters, and the tide of tourists would carry prosperity to Aliwal North, Fraserburg, Craddock, and Fort Beaufort.

From London to Kimberley by the Cape route is about 6700 miles, and is compassed in three weeks, although I would warmly recommend any one on pleasure bent to do as my wife and I did—spend a few days at Cape Town—before commencing the tedious railway journey to Kimberley.

The famous diamond mines in the neighbourhood are Kimberley, De Beers, Dutoitspan, Bulfontein, and Wesselton. They are situated in latitude 28° 43′ South, and longitude 24° 46′ East. The town itself is 4042 feet above sea-level. Other mines in the neighbourhood are worked for diamonds, but as yet they are unimportant. Kimberley is practically in the centre of the present diamond-producing area. Besides these mines, two others of some importance in the Orange Free State are known as Jagersfontein and Coffeefontein, about sixty miles from the Kimberley diamond region.

Kimberley.

The surface of the country round Kimberley is covered with a ferruginous red, adhesive, sandy soil, which makes horse traffic very heavy. Below the red soil is a basalt, much decomposed and highly ferruginous, from 20 to 90 feet thick, and lower still from 200 to 250 feet of black slaty shale containing carbon and iron pyrites. These are known as the Kimberley shales; they are very combustible, and in a part of the De Beers mine where they were accidentally fired, they smouldered for over eighteen months. Then follows a bed of conglomerate about 10 feet thick, and below the conglomerate about 400 feet of a hard compact rock of an olive colour, called "melaphyre" or olivine diabase. Below the melaphyre is a hard quartzite about 400 feet thick. The strata are almost horizontal, dipping slightly to the north: in places they are distorted and broken through by protruding dykes of trap. There is no water nearer than the Vaal river, about fourteen miles away, and formerly the miners were dependent on rain-water and a few springs and pools. Now, however, a constant and abundant supply of excellent water is served to the town, whilst good brick houses, with gardens and orchards, spring up on all sides. To mark the dizzy rate of progress, Kimberley has an excellent club and one of the best public libraries in South Africa. Parts of the town, affectionately called "the camp" by the older inhabitants, are not beyond the galvanised iron stage, and the general appearance is unlovely and depressing. Reunart reckons that over a million trees have been cut down to supply timber for the mines, and the whole country within a radius of 100 miles has been denuded of wood with the most injurious effects on the climate. The extreme dryness of the air, and the absence of trees to break the force of the wind and temper the heat of the sun, probably account for the dust storms so frequent in summer. The temperature in the day frequently rises to 100° in the shade, but in so dry a climate this is not unpleasant, and I felt less oppressed by this heat than I did in London the previous September. Moreover, in Kimberley, owing to the high altitude, the nights are always cool.

The approach to Kimberley is deadly dull. The country is almost treeless, and the bare veldt stretches its level length, relieved only by distant hills on the horizon.

The Pipes.

The five diamond mines are all contained in a circle 3½ miles in diameter. They are irregularly shaped round or oval pipes, extending vertically downwards to an unknown depth, retaining about the same diameter throughout. They are said to be volcanic necks, filled from below with a heterogeneous mixture of fragments of the surrounding rocks, and of older rocks, such as granite, mingled and cemented with a bluish coloured hard clayey mass, in which famous blue clay the imbedded diamonds are hidden.

The breccia filling the mines, usually called "blue ground," is a collection of fragments of shale, various eruptive rocks, boulders, and crystals of many kinds of minerals. Indeed, a more heterogeneous mixture can hardly be found anywhere else on this globe. The ground mass is of a bluish-green, soapy to the touch, and friable, especially after exposure to the weather. Prof. Maskelyne considers it to be a hydrated bronzite with a little serpentine. Besides diamonds, Moissan has detected more than eighty species of minerals in the blue ground, the more common being:—Magnetite, ilmenite, garnet, bright green ferriferous enstatite (bronzite), a hornblendic mineral closely resembling smaragdite, calc-spar, vermiculite, diallage, jeffreysite, mica, kyanite, augite, peridot, iron pyrites, wollastonite, vaalite, zircon, chrome iron, rutile, corundum, apatite, olivine, sahlite, chromite, pseudobrookite, perofskite, biotite, and quartz. The blue ground does not show any signs of passing through great heat, as the fragments in the breccia are not fused at the edges. The eruptive force was probably steam or water-gas, acting under great pressure, but at no high temperature. According to Mr. Dunn, in the Kimberley mine, at a depth of 120 feet, several small fresh-water shells were discovered in what appeared to be undisturbed material.

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[1] Two lectures delivered at the Imperial Institute, on November 16 and December 7, 1896, by Dr. William Crookes, F.R.S.

The rock outside the pipes and encasing them is called "reef." Inside some of the mines occur large masses of "floating reef," covering an area of several thousand square feet. In the De Beers mine is what is called "the snake," a dyke of igneous rock taking a serpentine course across the mine, and standing like a vein nearly vertical, varying in thickness from 2 to 7 feet.

The areas of the mines are:—

Kimberley	33 acres
De Beers	22 ,,
Dutoitspan	45 ,,
Bulfontein	36 ,,

Before the discovery of the mines there was nothing in the superficial appearance of the ground to indicate the treasures below. Since the volcanic ducts were filled with the diamantiferous ground, denudation has planed the surface and the upper parts of the craters, and other ordinary signs of volcanic activity being smoothed away, the superficial and ubiquitous red sand covered the whole surface. The Kimberley mine seems to have presented a slight elevation above the surrounding flat country, while the sites of other mines were level or even slightly depressed. The Wesselton mine, within a mile of Dutoitspan, has only been discovered a few years. It showed a slight depression on the surface, which had been used as a shoot for dry rubbish. There are other diamantiferous pipes in the neighbourhood, but they are small, and do not contain stones in payable quantities. More recently another diamantiferous pipe has been discovered about forty miles off, near Klipdam, and is now worked as the Leicester mine. Other hoards of diamonds may also be near; where there are no surface signs, and the pipe itself is hidden under 10 or 20 feet of recent deposits, it is impossible to prospect the entire country. Accident has hitherto been the chief factor in the discovery of diamond mines.

How the great pipes were originally formed is hard to say. They were certainly not burst through in the ordinary manner of volcanic eruption, since the surrounding and enclosing walls show no signs of igneous action, and are not shattered or broken up even when touching the "blue ground." It is pretty certain these pipes were filled from below after they were pierced, and the diamonds were formed at some previous time and mixed with a mud volcano, together with all kinds of débris eroded from the rocks through which it erupted. The direction of flow is seen in the upturned edges of some of the strata of shale in the walls, although I was unable to see any upturning in most parts of the walls of the De Beers mine at great depths.

The Kimberley mine is filled for the first 70 or 80 feet with what is called "yellow ground," and below that with "blue ground." This superposed yellow on blue is common to all the mines. The blue is the unaltered ground, and owes its colour chiefly to the presence of lower oxides of iron. When atmospheric influences have access to the iron it is peroxidised, and the ground assumes a yellow colour. The thickness of yellow earth in the mines is therefore a measure of the depth of penetration of air and moisture. The colour does not affect the yield of diamonds.

The contents of the several pipes are not absolutely identical. The diamonds from each pipe differ in character, showing that the upflow was not simultaneous from one large reservoir below, but the result of several independent eruptions. Even in the same mine there are visible traces of more than one eruption.

The blue ground varies in its yield of diamonds in different mines, but it is pretty constant in the same mine. In 1890, the yield per load of blue ground was—

From the	Kimberley mine	from	1·25	to	1·5	carats.
,,	De Beers mine	,,	1·20	,,	1·33	,,
,,	Dutoitspan mine	,,	0·17	,,	0·5	carat.
,,	Bulfontein mine	,,	0·5	,,	0·33	"

Both in Kimberley and De Beers the blue ground on the west side is poorer in diamonds than the blue ground in other parts of the mines. The diamonds from the west side also differ somewhat from those in other parts of the same mine. The diamonds from each mine have a distinctive character; so uniform are the characteristics that an experienced buyer can tell at once the locality of any particular parcel of stones. De Beers and Kimberley mines are distinguished by the yield of large yellowish crystals. Dutoitspan yields mainly coloured stones, while Bulfontein—half a mile off—produces small white stones, occasionally speckled and flawed, but rarely coloured. The diamonds from the Wesselton mine are nearly all irregular in shape; a perfect crystal is rare, and most of the stones are white, few yellow. The diamonds from the Leicester mine have a frosted, etched appearance; they are white, the crystallisation irregular ("cross-grained"), and they are very hard. Stones from Jagersfontein, in the Orange Free State, display great purity of colour and brilliancy; they have that so-called "steely" lustre characteristic of old Indian gems. Stones from this mine are worth nearly double those from Kimberley and De Beers.

In the first days of diamond mining there was no idea that diamantiferous earth extended to any particular depth, and miners were allowed to dig holes at haphazard, and prospect where they liked. When the Kimberley mine was discovered, a new arrangement was made, and in July 1871 it was cut up into about 500 claims, each 31 feet square, with spaces reserved for about fifteen roadways across the mine. No person at first could hold more than two claims—a rule afterwards modified.

It may help to realise the enormous value of the Kimberley mine if I tell you that two claims, measuring together 62 by 31 feet, and worked to a depth of 150 feet, yielded 28,000 carats of diamonds.

The roadways across the mine soon, however, became unsafe. Claims were sunk 100 or 200 feet each side of a roadway, and the temptation to undermine roadways was not always resisted. Falls of road frequently took place, followed by complete collapse, burying mine and claims in ruin. At that time there were probably 12,000 or 15,000 men at work in the mine, and then came the difficulty how to continue working the host of separate claims without interference with each other.

The mine was now threatened in two other quarters. The removal of the blue ground took away the support from the walls of the pipe, and frequent falls of reef occurred, not only covering up valuable claims with rubbish, but endangering the lives of workers below. Moreover, as the workings deepened, water made its appearance, necessitating pumping. In 1878 one quarter of the claims were covered by reef, and in 1879 over 300,000*l.* were spent on removing reef and water. In 1881 over 200,000*l.* were thus spent, and in 1882 more than half a million sterling was needed to defray the cost of reef removal. So matters went on until four million cubic yards of reef had been removed, at a cost of two millions sterling, and still little good was done, for out of 400 claims in the mine, only about 50 could be regularly worked. Ultimately, in November 1883, the biggest fall of reef on record took place, estimated at 250,000 cubic yards, surging half across the mine, where the bulk of it lies to this day. It became evident that open workings could not be carried on at such depths, and after many experiments the present system of underground working was devised.

During this time of perplexity, individual miners who could easily have worked one or two claims near the surface could not continue work in the face of harassing difficulties and heavy expenses. Thus the claims gradually changed hands, until the mine became the property first of a comparatively small number of capitalists, then of a smaller number of limited liability companies, until finally the whole of the mines have practically become the property of the "De Beers Consolidated Mines, Limited."

UNDERGROUND WORKINGS.

The system of underground working in use at the time of my visit is as follows:—Shafts are sunk in the solid rock at a sufficient distance from the pipe to be quite safe against reef movements in the open mine. The main shaft at De Beers starts about 540 feet from the north side of the mine, and is now over 1500 feet deep. Tunnels are driven from this shaft at different levels to cross the mine from west to east, about 120 feet apart. These tunnels are connected with each other by two tunnels running north and south, one near the west side of the mine and one midway between it and the east margin of the mine. From the east and west tunnels offsets are driven to the surrounding rock. When near the rock, they are widened into galleries, these in turn being stoped on the sides until they meet, and upwards until they break through the blue ground. The fallen reef with which the upper part of the mine is filled, sinks and partially fills the open space. The workmen then stand on the fallen reef, and drill the blue ground overhead; as the roof is blasted back the débris follows. When stoping between two tunnels, the blue is stoped up to the débris about midway between the two tunnels. The upper levels are worked back in advance of the lower levels, and the works assume the shape of irregular terraces. The main levels are from 90 to 120 feet apart, with intermediate levels every 30 feet. Hoisting is done from only one level at a time through the same shaft. By this ingenious method of mining, every portion of blue ground is excavated and raised to the surface, the rubbish on the top gradually sinking down and taking its place.

The scene below ground in the labyrinth of galleries is bewildering in its complexity, and is about as little like one's idea of a diamond mine as can well be conceived. Electric light is universal in the workings. One set of workers attends to the rock-drilling machines for blasting the blue ground; in other parts the blue is shovelled into wagons, which, when filled, are carried along rails by moving ropes till they get to the gallery, where the contents are sent to the surface.

At the bottom of the main shaft, at the 1300-foot level, the galleries converge to a large open space where the tram lines carrying the trucks meet. In front is a shoot to which the trucks full of blue ground are rapidly wheeled, tipped over, their contents discharged, when they are shunted to make way for other trucks. At the foot of the shoot is a skip holding 64 cubic feet, or four truck-loads. As soon as a skip has received its allotted four loads an electric bell sounds at the engine house, when the skip is hoisted to the surface and another takes its place. So the work proceeds, and on busy days ground has been hoisted at the rate of 20 loads every three minutes, equal to 400 loads an hour. In 1894 the record hoisting of blue ground at the Kimberley mine was 470 loads an hour; in one shift of eight hours 3312 loads; and in a day of three shifts, 7415 loads.

All below ground is dirty, muddy, grimy; half-naked men, black as ebony, muscular as athletes, with perspiration oozing from every pore, are seen in every direction, hammering, picking, shovelling, wheeling the trucks to and fro, keeping up a weird chant, which rises in force and melody when a titanic task requires excessive muscular strain. The whole scene is far more suggestive of a coal mine than a diamond mine, and all this mighty organisation, this strenuous expenditure of energy, this clever, costly machinery, this ceaseless toil of skilled and black labour, going on day and night, is just to win a few stones wherewith to deck my lady's finger!

At the four mines about 8000 persons are daily employed, namely, 1500 whites and 6500 blacks. The wages are—whites, 5*l.* or 6*l.* a week; blacks, underground, 4*s.* to 5*s.* a day, and above ground 21*s.* a week.

With gems like diamonds, where so large an intrinsic value is concentrated into so small a bulk, it is not surprising that robbery has to be guarded against in the most elaborate manner. The Illicit Diamond Buying (I.D.B.) laws are very stringent, and the searching, rendered easy by the "compounding" of the natives—which I shall describe presently—is of the most drastic character. It is, in fact, very difficult for a native employé to steal diamonds; even were he to succeed, it would be almost impossible to dispose of them, as a potential buyer would prefer to secure the safe reward for detecting a theft rather than run the serious risk of doing convict work on the Cape Town Breakwater for a couple of years.

The Depositing Floors.

Owing to the refractory character of blue ground fresh from the mines, it has to be exposed to atmospheric influences before it will pulverise under the action of water and mechanical treatment.

From the surface-boxes, into which the blue ground is tipped when it reaches the top of the main shaft, it is transferred to side-tipping trucks, and sent to the depositing floors by means of endless wire-rope haulage.

The depositing floors are prepared by removing the bush and grass from a fairly level piece of ground; this ground is then rolled smooth and hard. The floors extend over many square miles of country, and are surrounded by 7-foot barbed wire fences, vigilantly guarded day and night. The De Beers floors, on Kenilworth, are laid off in rectangular sections 600 yards long and 200 yards wide, each section holding about 50,000 loads. The ground from the Kimberley mine is the softest, and only needs a few months' exposure on the floors; the ground from De Beers is much harder, and requires at least six months' exposure; while some ground is so hard that it will not disintegrate by exposure to the weather under one or two years. The De Beers mine contains a much larger quantity of this hard blue ground than the other mines, and, in order to save the loss of time consequent on keeping an enormous stock of blue constantly on the floors, it has recently been decided to pass the harder and more refractory stuff direct from the mine through crushing mills.

For a time the blue ground remains on the floors without undergoing much alteration. But soon the heat of the sun and moisture produce a wonderful effect. Large pieces, hard as ordinary sandstone when taken from the mine, commence to crumble. At this stage the winning of the diamonds assumes more the nature of farming than mining. The ground is frequently harrowed and occasionally watered, to assist pulverisation by exposing the larger pieces to atmospheric influences. The length of time necessary for the ground to weather before it becomes sufficiently pulverised for washing depends on the season of the year and the amount of rain. The longer the ground remains exposed the better it is for washing.

In June 1895, the quantity of blue ground on the floors was 3,360,256 loads, representing diamonds to the value of nearly one million sterling. The risk of robbery at this stage of the operations is somewhat serious, and precautions are correspondingly elaborate. A native working on the floors may come across a large stone and secrete it about his person. Careful search soon reveals this crude form of robbery. Or he may hide it, note its position in the field, and after working hours creep back and furtively secure the prize. As a safeguard five powerful search-lights, each of 25,000 candle-power, sweep across the floors all night, and guards are on the watch to prevent any unauthorised person entering the mining area, and to prevent natives who are working at night from leaving the floors without being seen.

Washing and Concentrating Machinery.

After the blue ground has been weathered for a sufficient time, it is again loaded into trucks and hauled to the washing machinery.

About 14 per cent. of all the ground sent to the depositing floors are too hard to weather, so of late years crushing and concentrating plant has been erected to deal effectually with the hard lumps, thus saving the great lock-up of capital consequent on letting them lie on the floor a year or two.

The hard lumps being hauled to the upper part of the machine, are tipped into bins, whence they pass to crushing rollers which so reduce them that they will pass through a ring two inches in diameter. The coarse powder is screened through revolving cylinders having ½ inch and 1¼ inch perforations. The stuff passing through the finer holes goes to the finishing mill, while the coarser stuff goes to smaller crushers. Before the coarse lumps are re-crushed they pass over revolving picking tables, where any specially large diamonds are rescued, thus preventing the risk of breakage. Finally the crushed and graded stuff goes to a series of jigs, and after further concentration the diamantiferous gravel is taken in locked trucks to the pulsators.

The Pulsator.

The pulsator is an ingeniously designed but somewhat complicated machine for dealing with the diamantiferous gravel already reduced one hundred times from the blue ground; the pulsator still further concentrating it till the gravel is rich enough to enable the stones to be picked out by hand. The value of the diamonds in a load of original blue ground being about 30*s.*, the gravel sent to the pulsator from the pans, reduced a hundredfold, is worth 150*l.* a load. Stuff of this value must not be exposed to risk of peculation. The locked trucks are hoisted by a cage to a platform, where they are unlocked, and their contents fed into a shoot leading to a cylinder. This cylinder is covered with iron plates perforated in sections with four sizes of round holes, ⅛ inch, 3/16 inch, ¼ inch, and ⅜ inch in diameter. That portion of the deposit too coarse to pass through the ⅜-inch holes issues at the end of the cylinder, whence it goes direct to the sorting house. The four sizes which pass through the screens flow to the same number of jigs. The bottoms of the jigs are covered with screens the meshes of which are respectively ⅛ inch, $\frac{3}{16}$ inch, ¼ inch, and ⅜ inch square, thus corresponding with, but being a little coarser than the holes in the cylinder. Upon each screen is spread a layer of bullets to prevent the rich deposit from passing too rapidly through the screens. The jigs themselves are stationary, but from below an intermittent stream of water passes in rapid pulsations with an up and down movement. This pulsation keeps the diamantiferous gravel constantly moving—"alive" is the expressive word used—and tends to sort out the constituents roughly according to their specific gravity, the heavier particles working to the bottom and the lighter material washing off by the flow of water and passing into trucks, whence it is carried to the tailings heap. The heavier portions by the up and down wash of the water gradually work their way under the bullets and pass through the screens into pointed boxes, whence the contents are drawn off at intervals and taken to the sorting room.

SORTING OUT.

The sorting room in the pulsator house is long, narrow, and well lighted. Here the rich gravel is brought in wet, a sieve-full at a time, and is dumped in a heap on tables covered with iron plates. The tables at one end take the coarsest lumps, next comes the gravel which passed the ⅜ inch holes, then the next in order, and so on. The first sorting is done by thoroughly trustworthy white men; for here the danger of robbery is greatest. Sweeping the heap of gravel to the right, the sorter scrapes a little of it to the centre of the table by means of a flat piece of sheet zinc. With this tool he rapidly passes in review the grains, seizes the diamonds and puts them into a little tin box in front of him. The stuff is then swept off to the left, and another lot taken, and so on till the sieve-full of gravel is exhausted, when another is brought in. The stuff the sorter has passed to his left as temporarily inspected is taken next to another part of the room, where it is again scrutinised by native convicts again and again, and whilst diamonds can be found in quantity sufficient to repay the cost of convict labour, it is passed under examination.

The diamond has a peculiar lustre, and on the sorter's table it is impossible to mistake it for any other stone that may be present. It looks somewhat like clear pieces of gum arabic, with a sort of intrinsic lustre which makes a conspicuous shine among the other stones.

Besides diamonds, the following associated minerals reach the sorting tables:—

Pyrope (garnet), sp. gr. 3·7, containing from 1·4 to 3 per cent. of oxide of chromium; zircon, in flesh-coloured grains, but no crystals, sp. gr. 4 to 4·7; kyanite, sp. gr. 3·45 to 3·7, discernible by its blue colour and perfect cleavage; chrome diopside, sp. gr. 3·23 to 3·5, of a bright green colour; bronzite, sp. gr. 3·1 to 3·3; magnetite, sp. gr. 4·9 to 5·2; mixed chrome and titanium iron ore, sp. gr. 4·4 to 4·9, containing from 13 to 61 per cent. of oxide of chromium, and from 3 to 68 per cent. of titanic acid, in changeable quantities; hornblende, sp. gr. 2·9 to 3·4; barytes, sp. gr. 4·3 to 4·7; and mica.

In the pulsator and sorting house most of the native labourers are long sentence convicts, supplied with food, clothing, and medical attendance by the company. These men are necessarily well guarded, and all the white men in the works carry revolvers. I myself saw about 1000 convicts at work. I was told that insubordination is very rare. Apart from the hopelessness of a successful rising, there is little inducement to revolt; the lot of these diamond workers is preferable to life in the Government prisons, and they seem contented.

Sometimes as many as 8000 carats of diamonds come from the pulsator in one day, representing about 10,000*l.* in value.

Prodigious diamonds are not so uncommon as is generally supposed. Diamonds weighing over an ounce (151·5 carats) are not unfrequent at Kimberley, and, were it necessary, there would be no difficulty in getting together a hundred of them. Not long ago, in one parcel of stones at Wernher, Beit, and Co.'s office, I saw eight perfect ounce crystals, and one weighing two ounces. The largest diamond from the Kimberley mines weighed 428½ carats, or nearly 4 ounces troy. It measured 1⅞ inch through the longest axis, and was 1½ inch square. After cutting, it weighed 228½ carats, losing 200 carats in the process. The largest known diamond weighs 970 carats—over half a pound. It was found at the Jagersfontein mine. Diamonds smaller than a small fraction of a grain elude the sorters and are lost. A microscopic examination of blue ground from Kimberley, after treatment with appropriate solvents, shows the presence of microscopic diamonds, white, coloured, and black, also of boart and carbonado.

THE DIAMOND OFFICE.

From the pulsator the diamonds are sent to the general office in Kimberley to be cleansed in a boiling mixture of nitric and sulphuric acids. A parcel of diamonds loses about half a part per 1000 by this treatment.

After purification, the diamonds are handed to the valuators, who sort them into classes, according to size, colour, and purity. In the diamond office they are sorted into ten classes. In the year 1895 in 1141·8 carats of stones, the proportions of the different classes were as follows:—

Close goods (best stones)	53·8
Spotted stones	75·8
Fine cleavage	79·1
Flats	39·5
Macles	36·5
Ordinary and rejection cleavage	243·4
Rejection stones	43·2
Light and brown cleavage	56·9
Rubbish	371·8
	1000·0
Fine sand	141·8
	1141·8

From two to three million carats of diamonds are turned out of the De Beers mines in a year, and as five million carats go to the ton, this represents half a ton of diamonds. To the end of 1892, ten tons of diamonds had come from these mines, valued at 60,000,000*l.* sterling. This mass of blazing diamonds could be accommodated in a box five feet square and six feet high.

In the year ending June 1895, there were found 2,435,541½ carats of diamonds, realising 3,105,958*l.* During the same time the total expenditure amounted to 1,704,813*l.*, leaving a profit of 1,401,145*l.*

About half these expenses represent mine wages or other local expenses.

The De Beers Company could raise many more diamonds, but a superfluity would have the effect of lowering the price. The diamond is a luxury, and there is only a limited demand for it throughout the world. From 4 to 4½ millions sterling is as much as is spent annually in diamonds; if the production is not regulated by the demand, there will be over-production, and the trade will suffer. By regulating the output the directors have succeeded in maintaining prices since the consolidation in 1888.

Diamonds to the value of about a million annually are produced by outside companies and individuals.

THE COMPOUND SYSTEM.

One great safeguard against robbery is the "compound" system of looking after the natives. A "compound" is a large square, about 20 acres in extent, surrounded by rows of one-storey buildings of corrugated iron. These are divided into rooms holding each about twenty natives. A high iron fence is erected around the compound, 10 feet from the buildings. Within the enclosure is a store, where the necessaries of life are supplied to the natives at a reduced price, wood and water being provided free of charge. In the middle is a large swimming-bath, with fresh water running through it. The rest of the space is devoted to recreation, games, dances, concerts, and any other amusement the native mind can desire. In case of accident or illness there is a well-appointed hospital, where the sick are tended. Medical supervision, nurses, and food are supplied free by the Company.

In the compound are to be seen nearly all the best types of African tribes. Each tribe keeps to itself, and to go round the buildings skirting the compound is an admirable object-lesson in ethnology. At one part is a group of Zulus; next we come to Fingoes; then Basutos; beyond come Matabele, Bechuanas, Pondos, Shangains, Swazis, and other less-known tribes, each forming a group by itself, or wandering about making friendly calls.

The clothing in the compound is diverse and original. Some of the men are great dandies; others think that in so hot a climate a bright coloured pocket-handkerchief is as great a compliance with the requirements of civilisation as can be expected.

They get very good wages, varying according to the work. The work is appreciated, and there are always more applicants than can be accepted. On entering, the restrictions to which they must submit are fully explained, and they are required to sign for three months at least, during which time they must not leave the compound or mine. A covered way and tunnel lead the workers underground to the down shaft, while those working on the depositing floors go and come under guard. It is seldom that a man does not return, once he has lived the life in the compound; some come again and again for years, only leaving occasionally to spend accumulated savings. Some of the careful men contrive to save money. They carry it at intervals to Captain Dallas to keep for them. Occasionally they ask to look at their savings, which may amount to 30*l.* or 40*l.*, accumulated by driblets. They are ignorant of savings banks or interest, and are content if they see their own money in the original rags and papers in which it was handed in. Sometimes Captain Dallas will have as much as 1000*l.* of these savings in his care. On leaving, the men generally draw all their savings, and it is not uncommon for a grateful Kaffir to press 2*l.* or 3*l.* on Captain Dallas in recognition of his trouble. They are astonished when their offerings are declined; still more so when it is explained that if they would put their savings in a bank, they would have a few extra pounds given to them for the privilege of taking care of it. Bank accounts are beyond them. The Kaffir, on demand, must behold his coins just as he handed them in, wrappings and all.

So much then for the diamond mining industry of Kimberley as I found it on my visit in the early part of 1896. I trust I have made you realise something of the daily life of the diamond miners, of the skill and ingenuity with which their labours are controlled, and of the vicissitudes through which a diamond must pass before it is fit to blaze in a ring or a tiara.

As for myself, I like to look back on our visit, and I am glad we made the journey. I like to recall the dusky natives at work and at play, with their smiling, good-natured faces. And I am glad to have seen that Arabian Nights vision, the strong room of the De Beers Company, literally heaped with stones won from the blue ground, purified, flashing, and of inestimable price, ready to play their part in the lives of men and women. And above all, I like to recall the friendly welcome, the thousand acts of kindness shown us by our able and enterprising colonial fellow countrymen.

THE DIAMOND.

I will briefly survey the chief chemical and physical characteristics of the diamond. I need scarcely say it is almost pure carbon, and is the hardest substance in nature. When heated in air or oxygen to a temperature varying from 760° to 875° C., according to its hardness, the diamond burns with production of carbonic acid. It leaves an extremely light ash, sometimes retaining the shape of the crystal, consisting of iron, lime, magnesia, silica, and titanium. In boart and carbonado, the amount of ash sometimes rises to 4 per cent., but in clear crystallised diamonds it is seldom higher than 0·05 per cent. By far the largest constituent of the ash is iron.

The specific gravity of the diamond is from 3·514 to 3·518. For comparison, I give in tabular form the specific gravities of the different varieties of carbon:—

Amorphous carbon	1·45	to 1·70
Graphite	2·11	,, 2·26
Hard gas coke	2·356	
Boart	3·47	,, 3·49
Carbonado	3·50	
Diamond	3·514	,, 3·518

The diamond crystallises in octahedra. It frequently occurs with curved faces and edges. Twin crystals (macles) are not uncommon. The crystals frequently contain microscopic cavities, and Brewster, by means of polarised light, found that the diamond round these cavities showed evidence of strain, as if from the presence of included gas at high pressure.

Some crystals of diamonds have their surfaces beautifully marked with equilateral triangles, interlaced and of varying sizes. Under the microscope these markings appear as shallow depressions sharply cut out of the surrounding surface, and these depressions were supposed by Gustav Rose to indicate the probability that the diamonds had at some previous time been exposed to incipient combustion. Rose pointed out that similar triangular striations appeared on the surfaces of diamonds burnt before the blowpipe. I have satisfied myself that during combustion before the blowpipe, in the field of a microscope, the surface is etched with triangular markings very different in character from those naturally on crystals. The artificial striæ are much smaller and massed closer together, looking as if the diamond during combustion flaked away in triangular chips, while the markings natural to crystals appear as if produced by the crystallising force as they were being built up. Many crystals of chemical compounds, alum, for instance, appear striated from both these causes. Geometrical markings can be produced by eroding the surface of a crystal with water, and they also occur naturally during crystallisation.

Some diamonds have enclosed in their substance black uncrystallised particles of graphite. There also occur what may be considered intermediate forms between the well-crystallised diamond and graphite. These are "boart" and "carbonado." Boart is an imperfectly crystallised form of diamond, having no clear portions, therefore being useless for gems. Boart is frequently found in spherical globules, and may be of all colours. Being very hard it is used in rock-drilling, and, when crushed, for cutting and polishing other stones. Carbonado is the Brazilian term for a still less perfectly crystallised form of carbon. It is equally hard, and occurs in porous masses, and in massive black pebbles, sometimes weighing a couple or more ounces.

Many diamonds after exposure for some time to the sun give out light when viewed in a dark room. Some diamonds are fluorescent, appearing milky in sunlight. In a vacuum, exposed to a high-tension current of electricity, diamonds phosphoresce of different colours. In these circumstances most South African diamonds shine with a bluish light. Diamonds from other localities shine with different colours, such as bright blue, apricot, pale blue, red, yellowish green, orange, and pale green. The most phosphorescent diamonds are those which are fluorescent in the sun. One beautiful green diamond in my collection, when phosphorescing in a good vacuum, gives almost as much light as a candle; the light is pale green—almost white.

During molecular bombardment the diamond becomes discoloured, and in course of time becomes black on the surface. Some diamonds blacken in the course of a few minutes, while others require an hour or more to discolour. This blackening is only superficial, and although no ordinary means of cleaning will remove the discolouration, it goes at once when the stone is polished with diamond powder. Ordinary oxidising reagents have little or no effect in restoring the colour. The black stain on the diamond is not due to a layer of amorphous carbon, but to graphite, which is much more resistent to oxidation. It is not necessary to expose the diamond in a vacuum to electrical excitement in order to produce a change. Some diamonds phosphoresce when exposed to the sun's rays or to an electrical discharge in the air, and many more are phosphorescent when exposed to the Röntgen rays. In the latter case a slight superficial blackening also takes place.

The diamond is remarkable in another respect. It is extremely transparent to the Röntgen rays, whereas highly refracting glass, used in imitation diamonds, is almost perfectly opaque to them. I exposed a flat plate of diamond, 0·0786 inch thick, and in shape a perfect equilateral triangle, side by side with a piece of glass of the same shape and thickness, over a photographic plate to the X-rays for a few seconds. On development the impression was found to be very feeble where the diamond obscured the rays, showing that most passed through, while the glass was seen to have obstructed all of them.

By this means imitation diamonds and some other false gems can readily be identified and distinguished from the true gems.

Diamonds occur in all shades, from deep yellow to pure white and jet black, from deep brown to light cinnamon, also green, blue, pink, yellow, orange, and opaque.

I have shown how interesting is Kimberley with reference to its buried diamond wealth. The enormous find and exportation of diamonds must bring reciprocal benefit; and it would redound to our credit could we honourably do our part towards the pacification and development of the colony.